



**NOAA  
FISHERIES**

# **Vulnerability Analyses: A framework for evaluating climate effects on Living Marine Resources**

**Marine Fisheries Advisory Committee**

November 2016



**NOAA FISHERIES**

# Growing Challenges for Effective Management



Droughts

Warming  
Oceans

Loss of Sea Ice

Rising Seas

Ocean  
Acidification

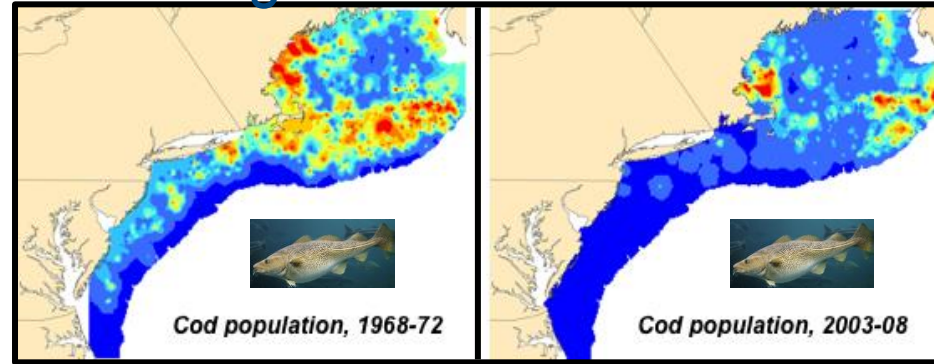


# The impacts are real...

## Changing Productivity



## Shifting Distributions



## Changing Abundance



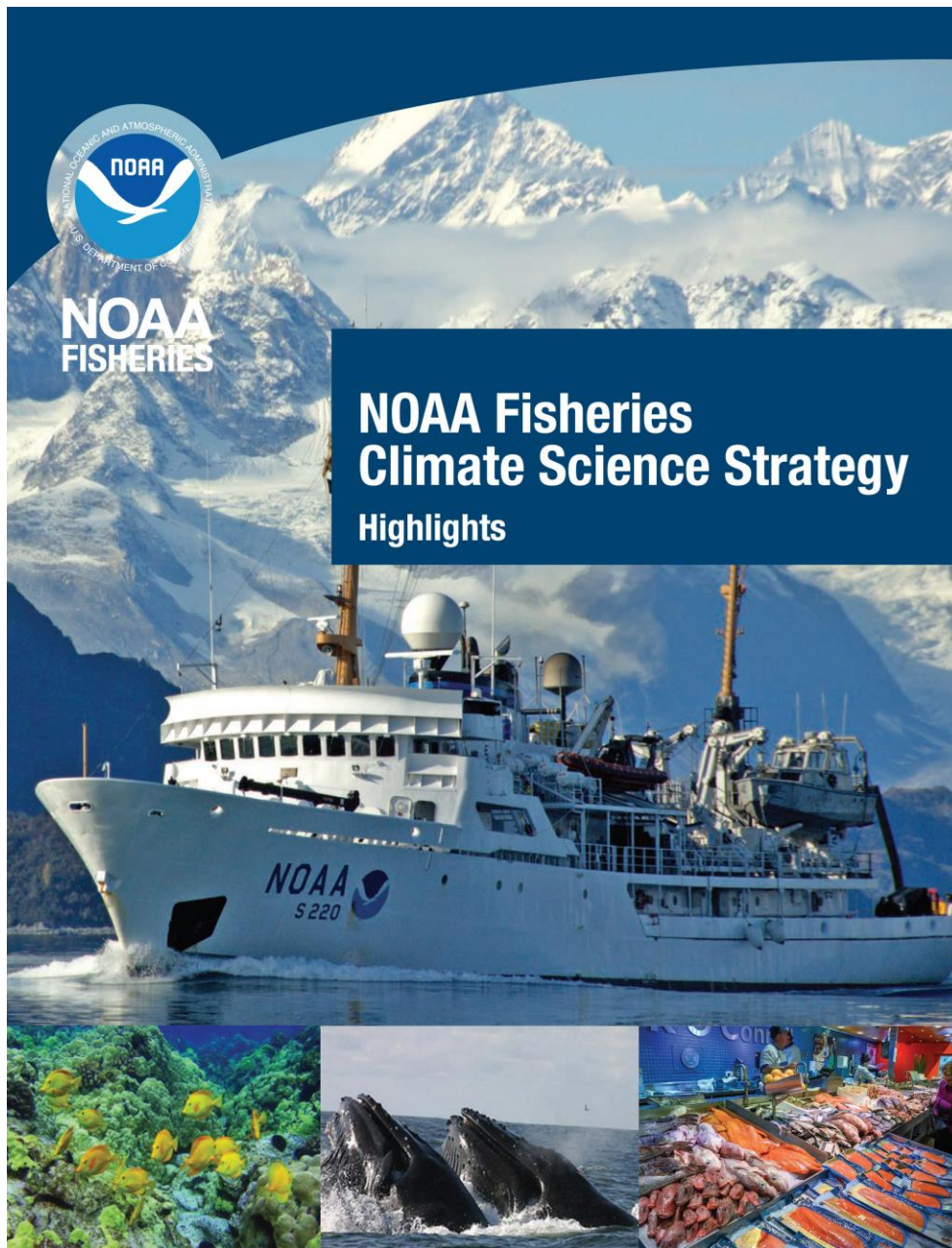
## Changing Fisheries



# There is much at risk nationally.

- 1.7 million jobs
- \$ 200 billion
- Recreation/tourism
- Food security
- Coastal protection
- Natural heritage





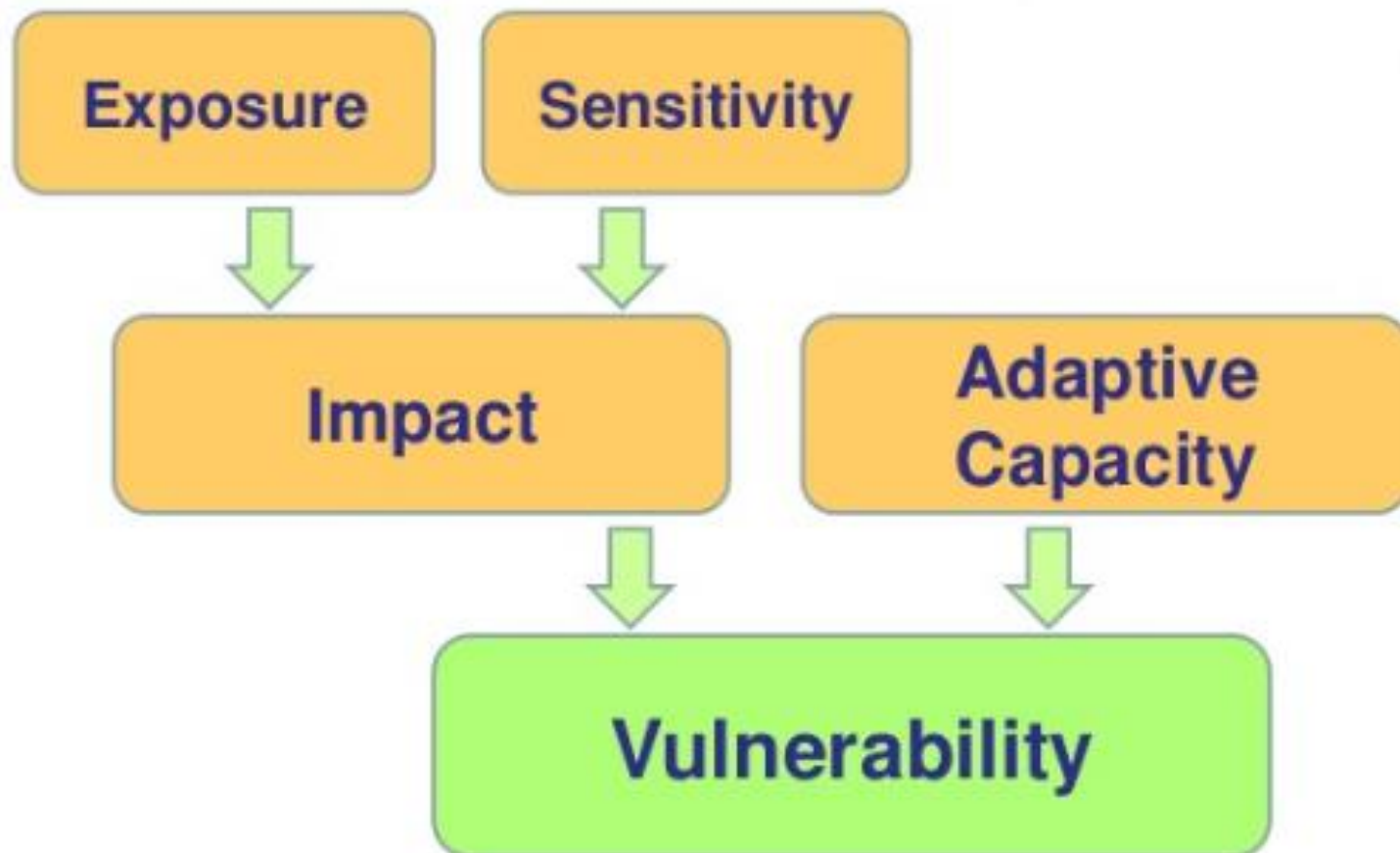
**Goal:**  
**Increase the  
production,  
delivery and use  
of climate-related  
information  
In fulfilling  
NOAA Fisheries  
mandates**

# Fish Stock Climate Vulnerability Assessments



**Goal: Assess the vulnerability fish and invertebrate species to changing climate/ocean conditions to help inform science and management actions.**

# Vulnerability Assessment Framework



*IPCC-oriented definition of vulnerability*

# NMFS Fisheries Climate Vulnerability Assessment

- Review of Vulnerability Assessment Methodologies
- NMFS Workshop to Develop Methodology
- Pilot Implementations: Northeast, Southeast
- Finalization of Methodology
- Full Northeast Implementation
- CIE Review
- Publication of Methodology and Northeast Implementation

## **Methodology for Assessing the Vulnerability of Marine Fish and Shellfish Species to a Changing Climate**

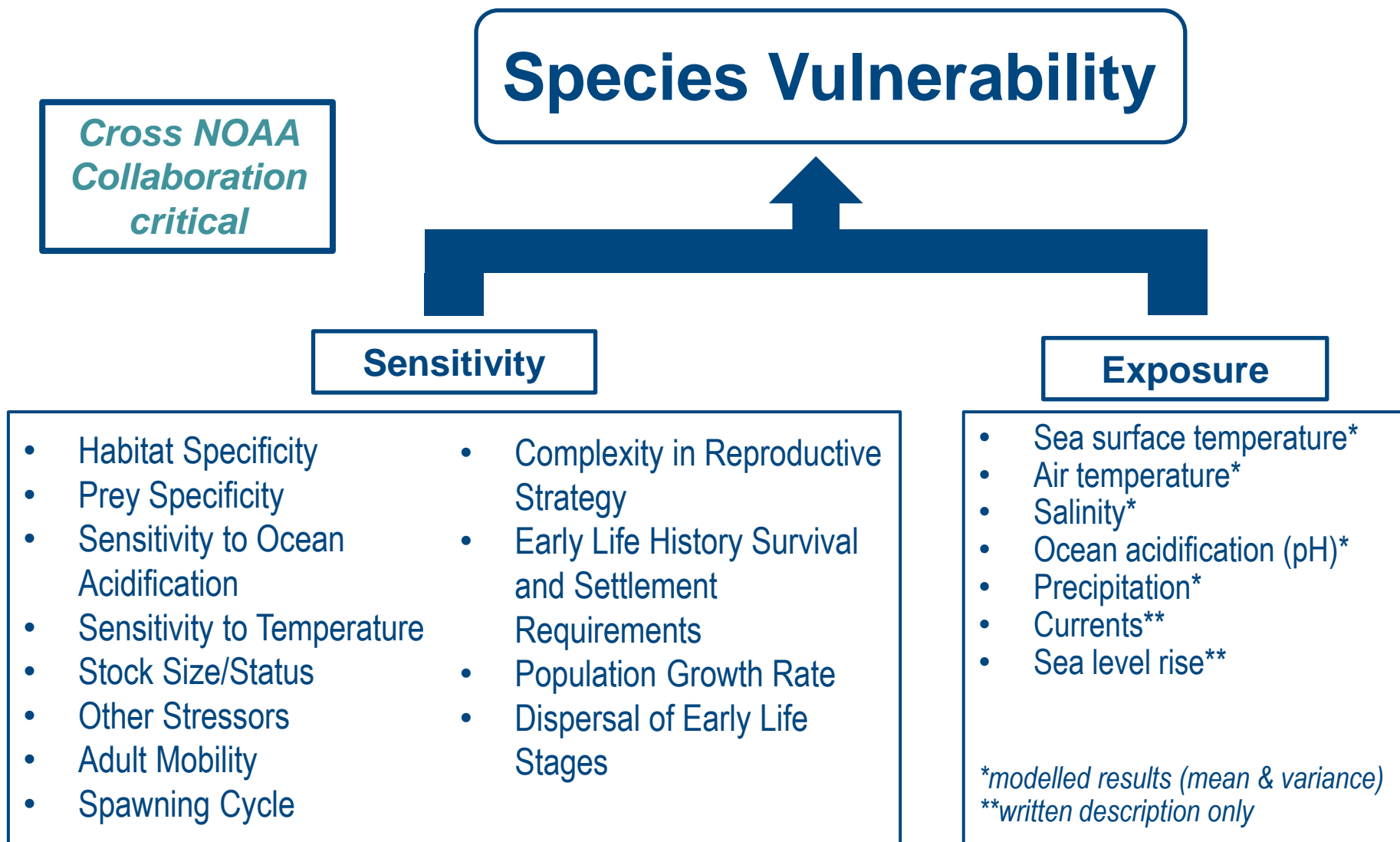
Wendy E. Morrison, Mark W. Nelson, Jennifer F. Howard, Eric J. Teeters, Jonathan A. Hare, Roger B. Griffis, James D. Scott, and Michael A. Alexander

October 2015



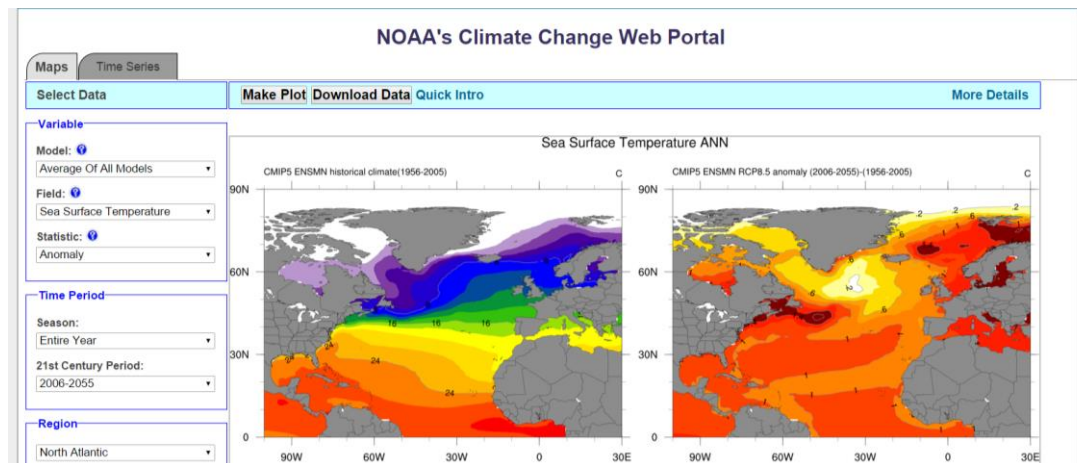
NOAA Tech Memo NMFS-OSF-3

# Fish Stock Climate Vulnerability Assessments



# What Information is Produced?

1. Overall vulnerability to changes in productivity
2. Propensity for changes in distribution
3. Overall Directional Score (+, -)
4. Species Vulnerability Narratives (2-3 pages per species)
5. NOAA Climate Change Web Portal (OAR ESRL)

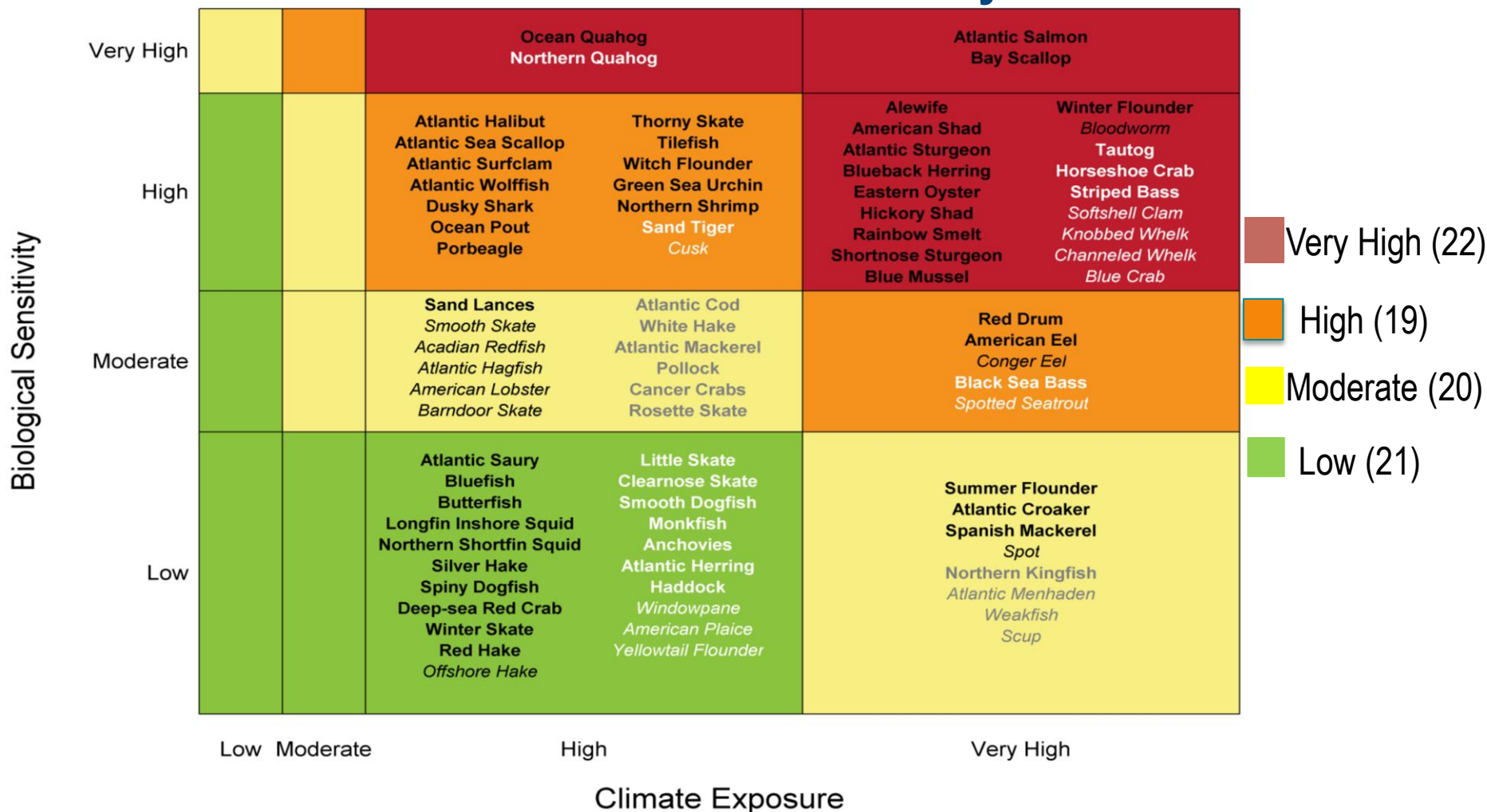


# Northeast Fisheries Climate Vulnerability Assessment (NEVA): First Implementation of a National Methodology

Jon Hare, Wendy Morrison, Mark Nelson, Megan Stachura,  
Eric Teeters, Roger Griffis, Mike Alexander, Jamie Scott,  
Larry Alade, Rich Bell, Toni Chute, Keirsten Curti, Tobey  
Curtis, Dan Kircheis, John Kocik, Sean Lucey, Cami  
McCandless, Lisa Milke, Dave Richardson, Eric Robillard,  
Harvey Walsh, Conor McManus, and Katey Marancik

# What Are the Results?

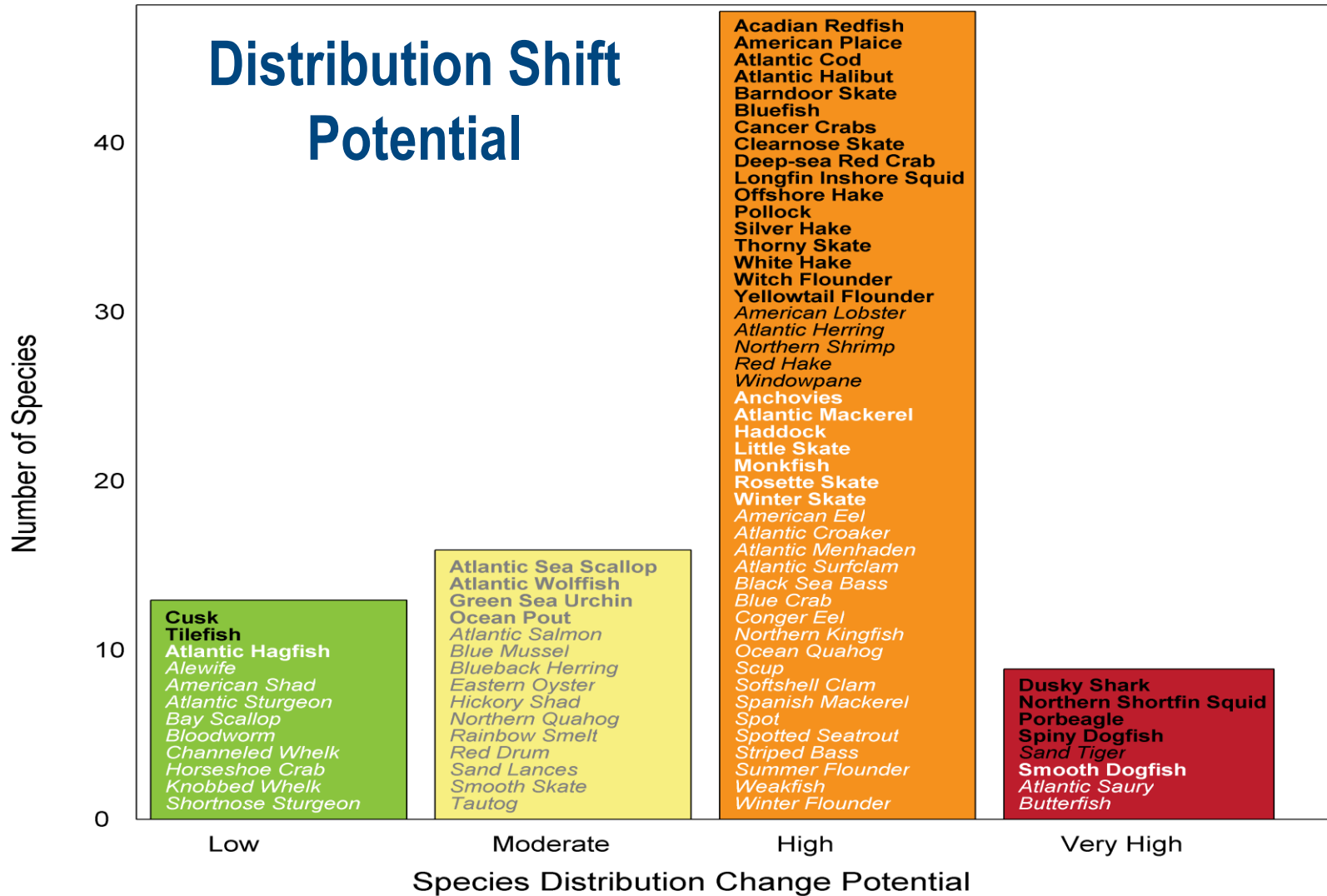
## Relative Vulnerability



82 fish and invertebrate species from Northeast U.S. Shelf Ecosystem

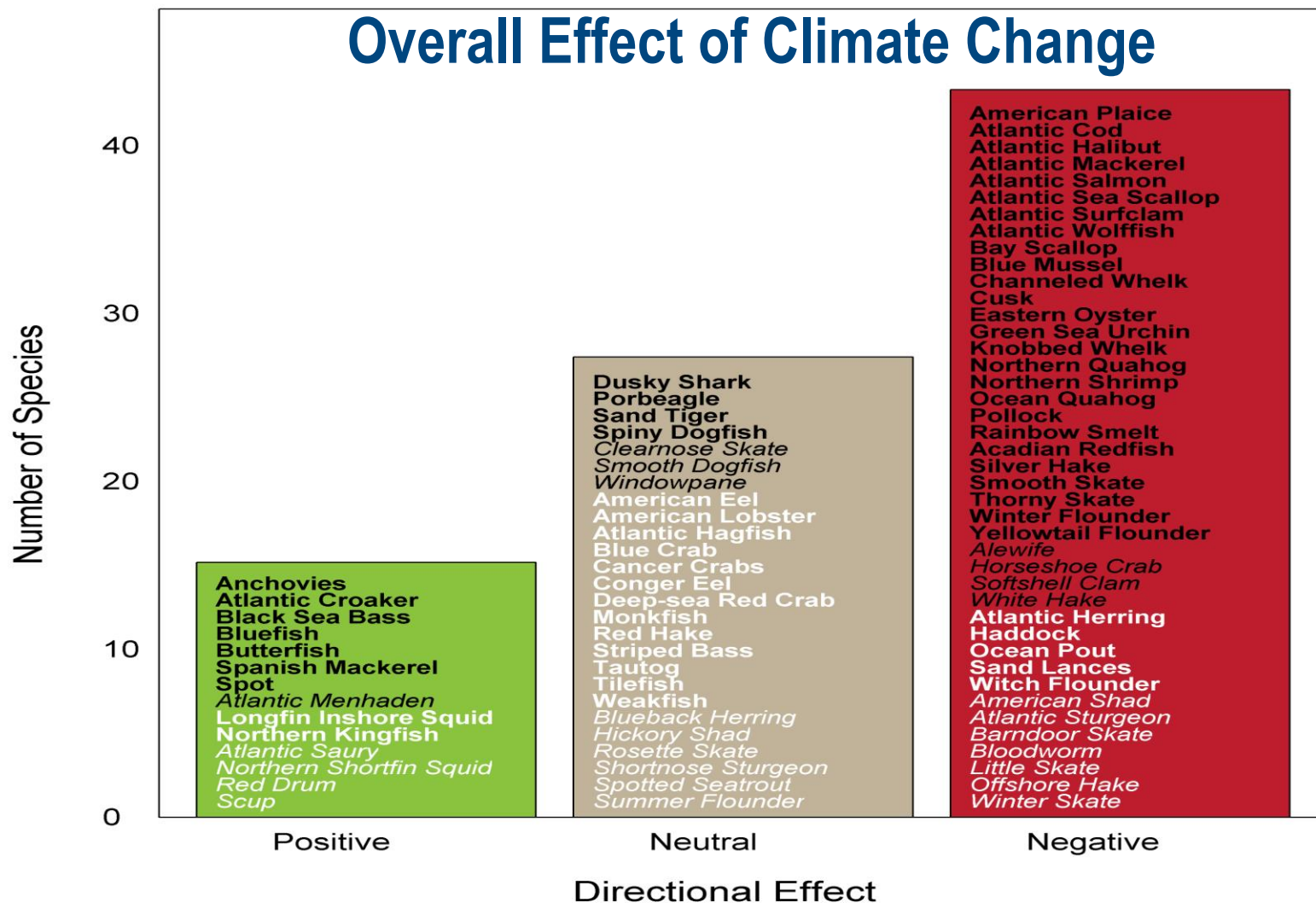


# What Are the Results?



82 fish and invertebrate species from Northeast U.S. Shelf Ecosystem

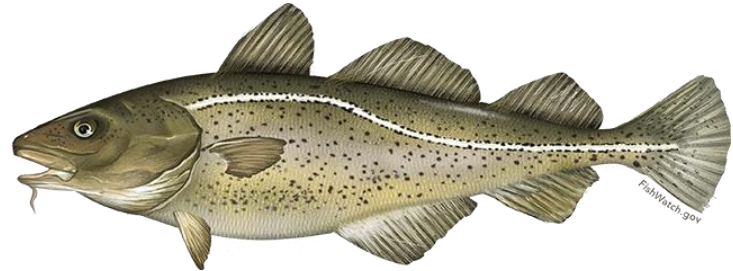
# What Are the Results?



82 fish and invertebrate species from Northeast U.S. Shelf Ecosystem

# Species Specific Results

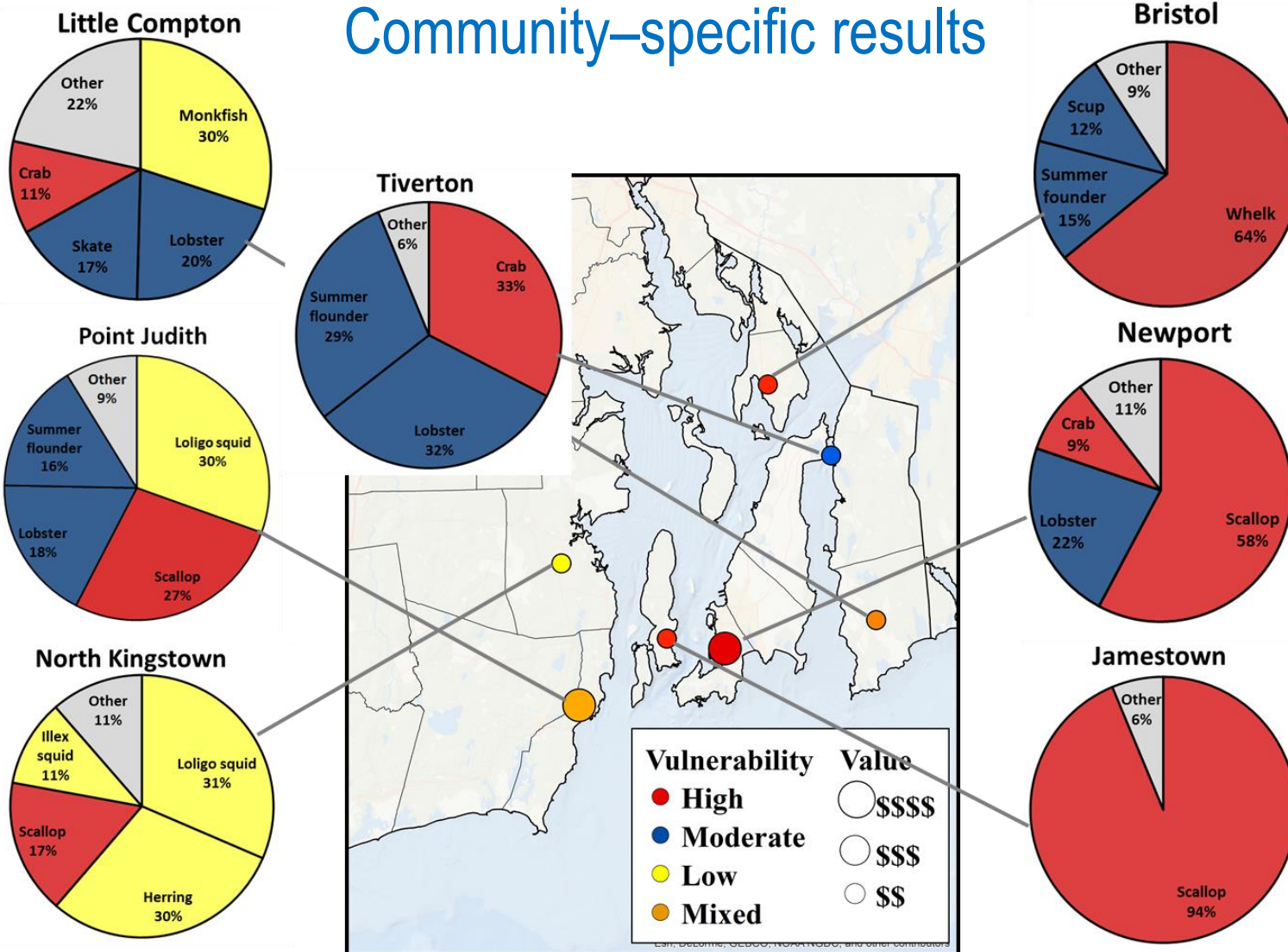
## Atlantic Cod:



1. Vulnerability to changes in **productivity**: **Moderate**
2. Propensity for changes in **distribution**: **High**
3. Overall **directional change**: **Negative**
4. Species **Vulnerability Narrative**:
  - Summary of results and current understanding of climate effects on Atlantic Cod

# Multiple Indicators of Fishing Community Vulnerability

## Community-specific results



# How Will the Results be Used?

## ***Management:***

- Advise Fisheries Management Plans, EISs, etc
- Helps identify scenarios and potential management actions that will increase stock resilience in a changing climate
- Support resilient fishing communities

## ***Science:***

- Shape research priorities
- Identify stocks that could benefit from increased monitoring to better quantify when expected climate impacts occur
- Identify stocks that can benefit from incorporating environmental parameters into stock assessments/stock structure

# Next Steps

- Complete Fisheries Climate Vulnerability Assessments in all regions.
- Link regional Fisheries Assessments to Social Indicators.
- Develop and implement Climate Vulnerability Assessments for
  - Marine Mammals and Sea Turtles
  - Habitats
- Consider Aquaculture Climate Vulnerability Assessments
- Update Vulnerability Assessments based on new IPCC projections (~FY18)
- Use Vulnerability Assessments to complement and guide more quantitative assessments.